

# Adaptive Stormbox

Flexible Green Infrastructure Assemblage Units for Galena Park, TX

Galen Newman, TAMU SRP

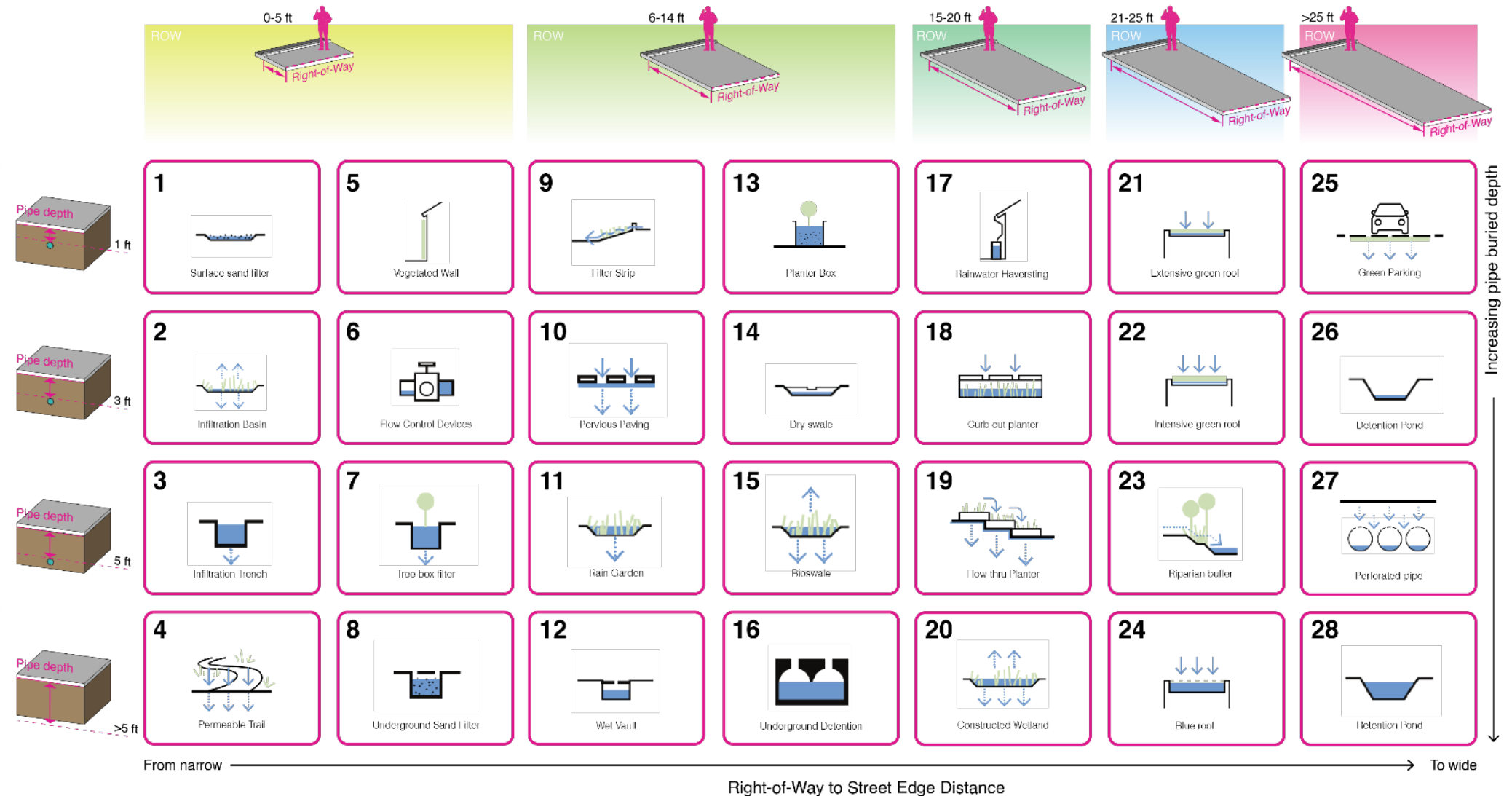
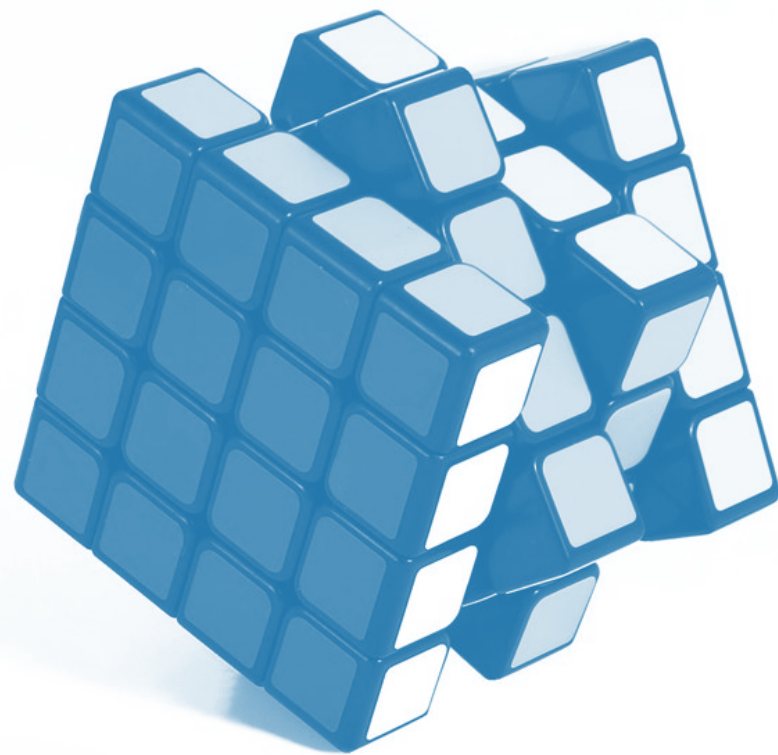


TEXAS A&M UNIVERSITY  
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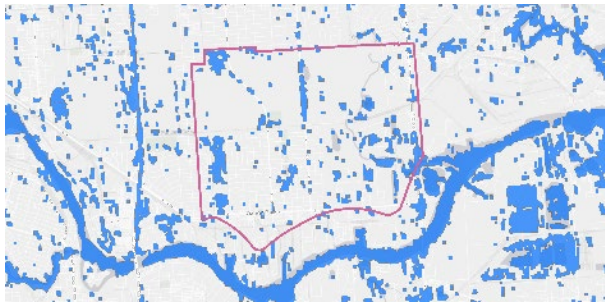



# Adaptive Stormbox

Exposure to hazardous substance transfer during flood events in Galena Park requires urgent updates for flood infrastructure that can capture and consume the excess stormwater.

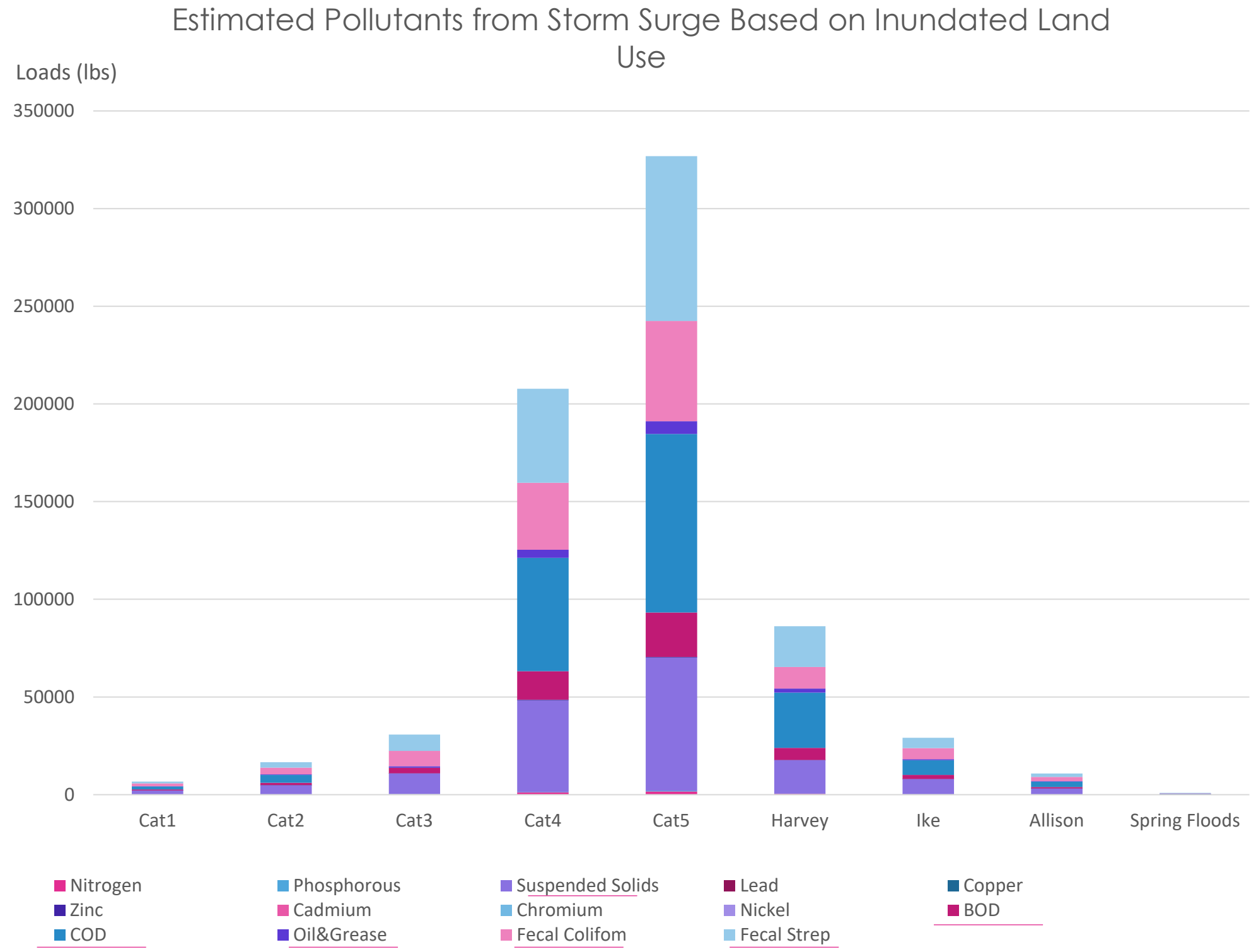
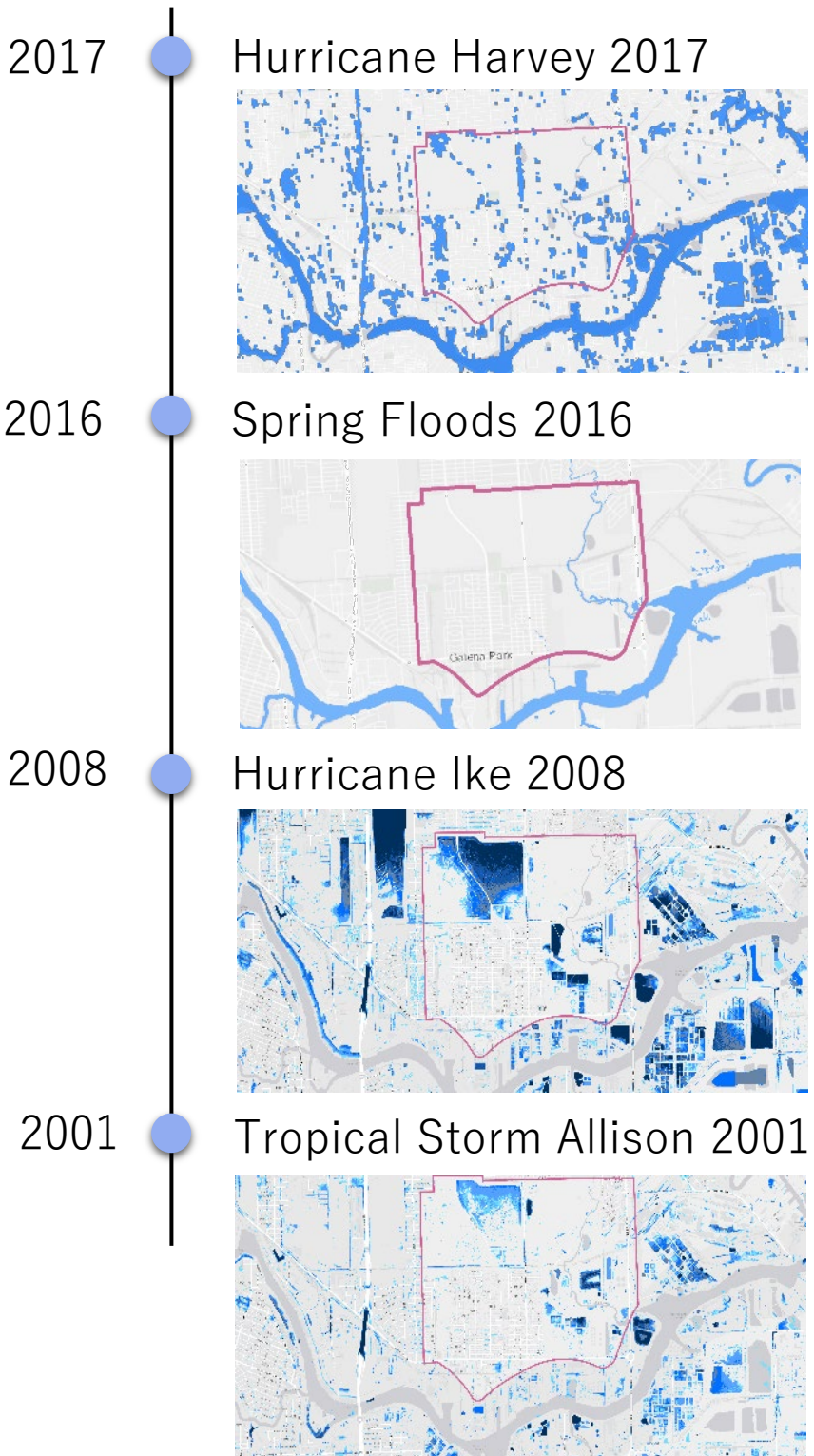
This toolbox provides improvement strategies that adapt to limited space and complex conditions in an established infrastructure system.



# Severe Flood Events in Galena Park

Year	Event	Overall Impact	Overall Impact	Impact to Galena Park
2017	Hurricane Harvey 2017 	Total Economic Loss <b>125 billion</b> Storm Surge 12-19 ft	Residents Relocation <b>60,049</b> Flooded Homes 154,170	Inundation Percent <b>17.3%</b> Inundated Industrial Sites 58.3 Acre
2016	Spring Floods 2016 	Total Economic Loss <b>65 million</b> Storm Surge 13-17 inch	Residents Relocation <b>300</b> Flooded Homes 9,820	Inundation Percent <b>1.2%</b> Inundated Industrial Sites 2.1 Acre
2008	Hurricane Ike 2008 	Total Economic Loss <b>351 million</b> Storm Surge 12-15 ft	Residents Relocation <b>1.2-1.5 million</b> Flooded Homes 2,550	Inundation Percent <b>9.2%</b> Inundated Industrial Sites 67.5 Acre
2001	Tropical Storm Allison 2001 	Total Economic Loss <b>5 billion</b> Storm Surge 20-30 inch	Residents Relocation <b>30,000</b> Flooded Homes 73,000	Inundation Percent <b>3.4%</b> Inundated Industrial Sites 28.1 Acre

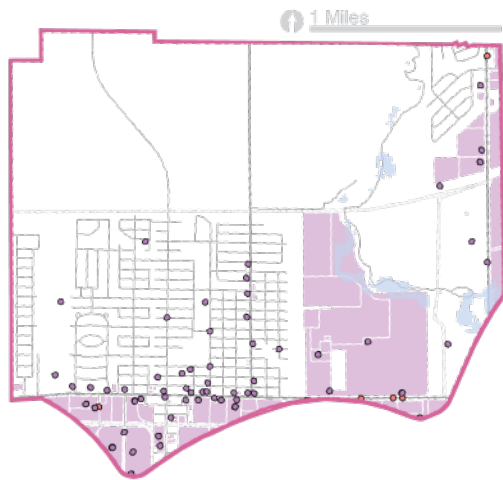
# Severe Flood Events in Galena Park



# Projected Future Storm Surge

## Category 1

Hurricane Inundation Area: **53.9 Acre**  
 Inundated Industrial Zone: **40.2 Acre**  
 Inundated TCEQ Facilities: 0  
 Inundated TRI Facilities: 0



Inundation Percent Industrial Percent

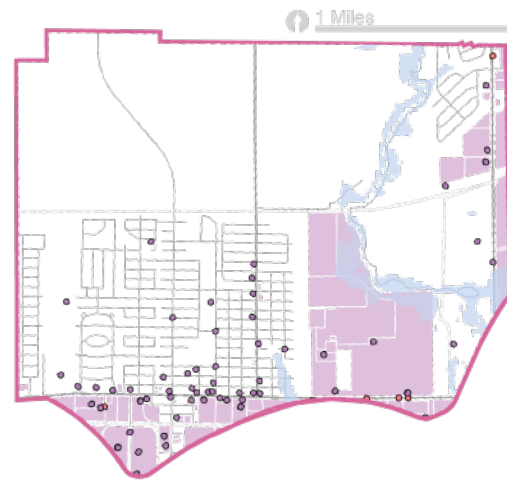


Inundated Facility Types



## Category 2

Hurricane Inundation Area: **152.8 Acre**  
 Inundated Industrial Zone: **81.5 Acre**  
 Inundated TCEQ Facilities: 0  
 Inundated TRI Facilities: 0



Inundation Percent Industrial Percent

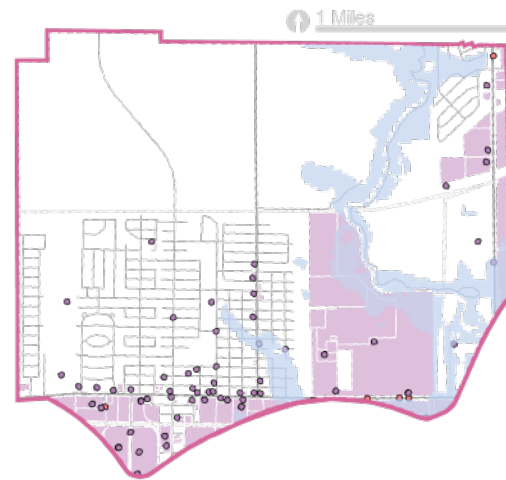


Inundated Facility Types

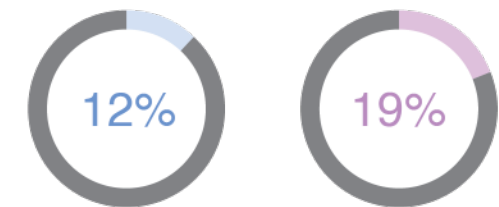


## Category 3

Hurricane Inundation Area: **396.8 Acre**  
 Inundated Industrial Zone: **152.7 Acre**  
 Inundated TCEQ Facilities: 4  
 Inundated TRI Facilities: 0



Inundation Percent Industrial Percent

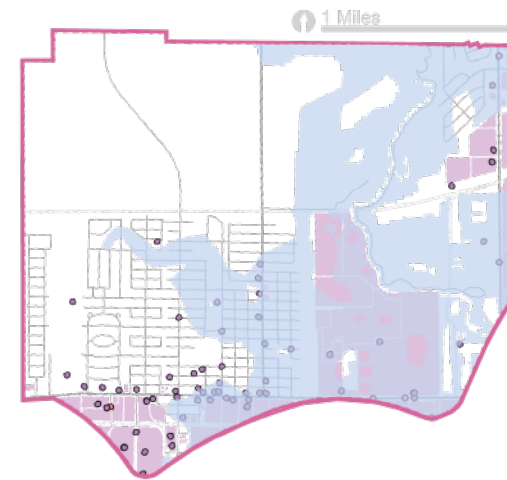


Inundated Facility Types

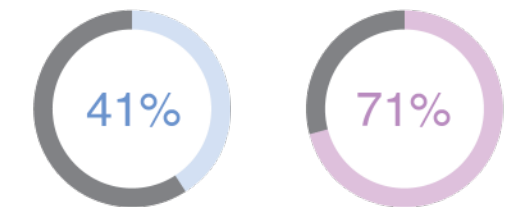


## Category 4

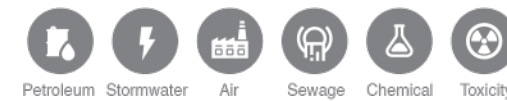
Hurricane Inundation Area: **1314.9 Acre**  
 Inundated Industrial Zone: **568.9 Acre**  
 Inundated TCEQ Facilities: 36  
 Inundated TRI Facilities: 4



Inundation Percent Industrial Percent

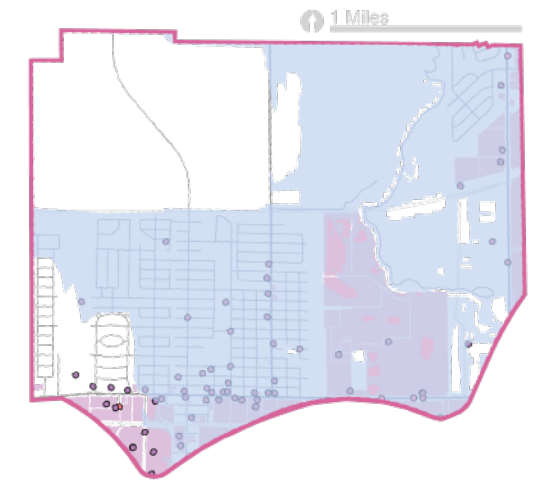


Inundated Facility Types

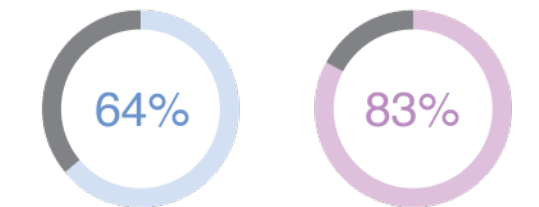


## Category 5

Hurricane Inundation Area: **2045.4 Acre**  
 Inundated Industrial Zone: **668.2 Acre**  
 Inundated TCEQ Facilities: 57  
 Inundated TRI Facilities: 4



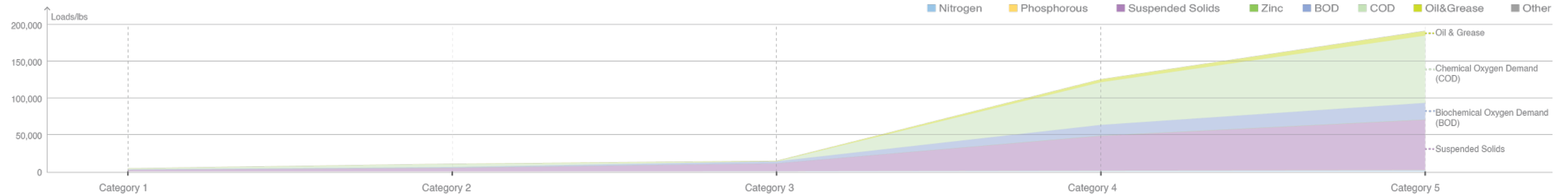
Inundation Percent Industrial Percent



Inundated Facility Types



## Chemical Contaminations



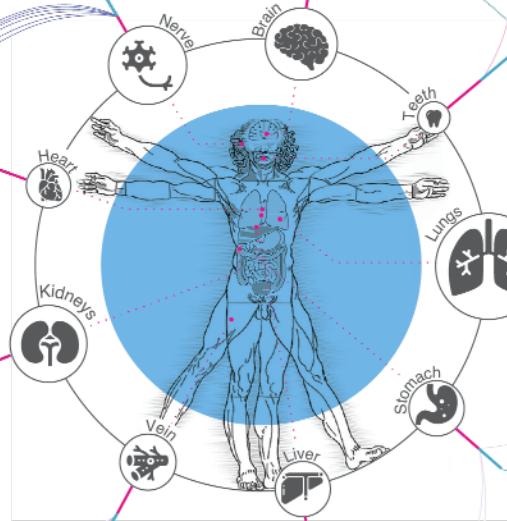
# Pollution-Related Disease Prevalence (Source: CDC 2019)

## Non-point Source Pollutants

- Nitrogen
- Phosphorous
- Lead
- Copper
- Zinc
- Cadmium
- Chromium
- Nickel
- Fecal Colifom

## Point Source Pollutants

- Xylene
- Methanol
- Toluene
- Benzena
- Ethylene glycol
- n-Hexana
- Dissocyanates
- Ethylbenzene
- 1 1 1-Trichloroethane
- Ammonia
- Cumene
- Phosphoric acid
- Hydrochloric acid
- 1 2 2-Trimethylbenzene
- Barium
- Copper
- Dissocyanates
- Lead

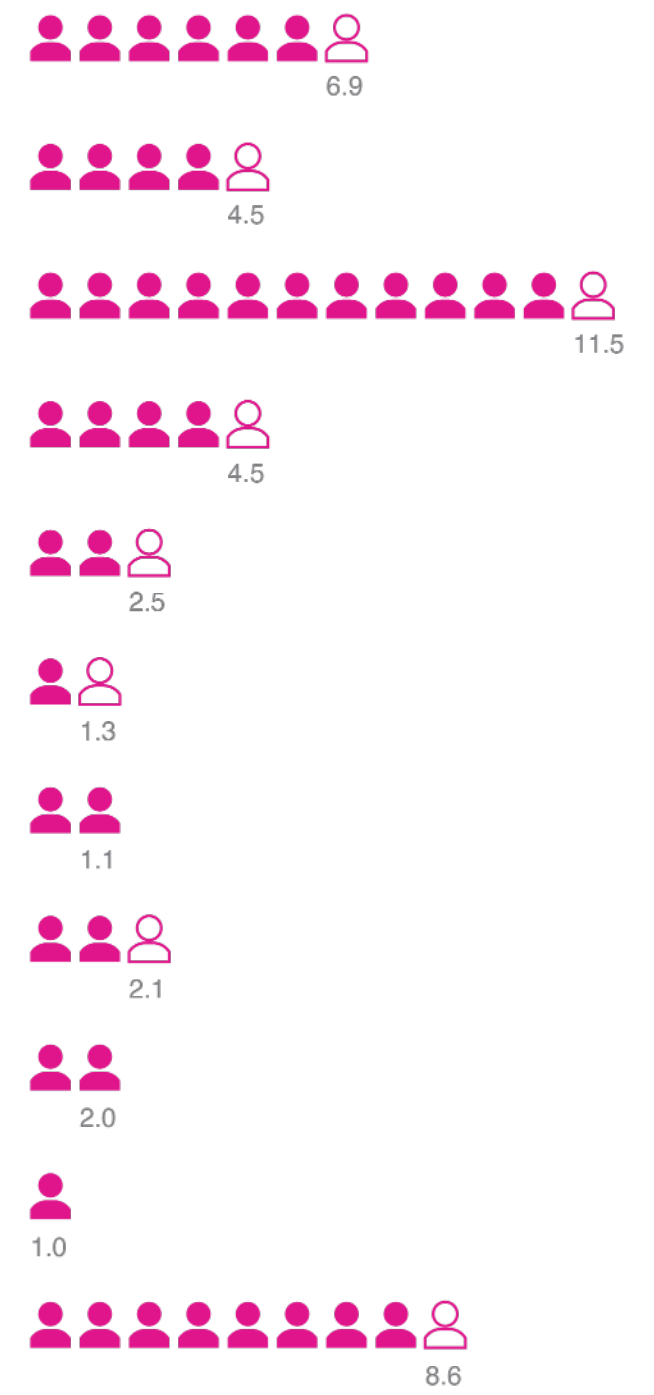


## City Ranking in Harris County

- NO. 1
- NO. 2
- NO. 3
- NO. 3
- NO. 3
- NO. 3
- NO. 4
- NO. 4
- NO. 4
- NO. 4
- NO. 5

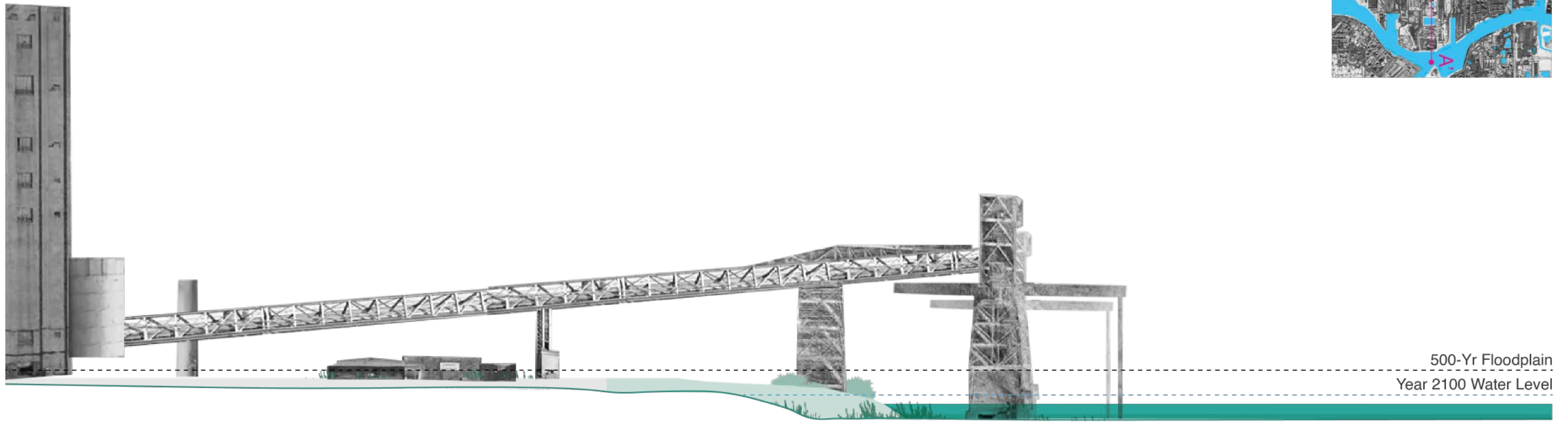
- Teethlost
- Physical health not good
- Obesity
- Mental health not good
- Diabetes
- Chronic obstructive pulmonary
- Stroke
- Asthma
- Coronary heart disease
- Chronic kidney disease
- High blood pressure

## Estimated prevalence in 1000 people



# Riparian Zone Section View

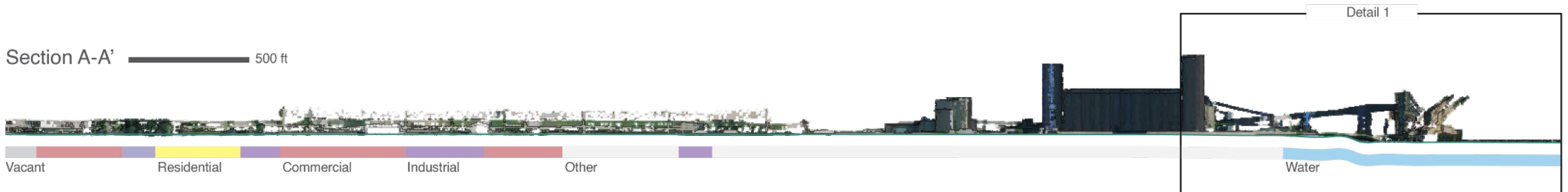
Detail Section 1  100 ft



Locator 1

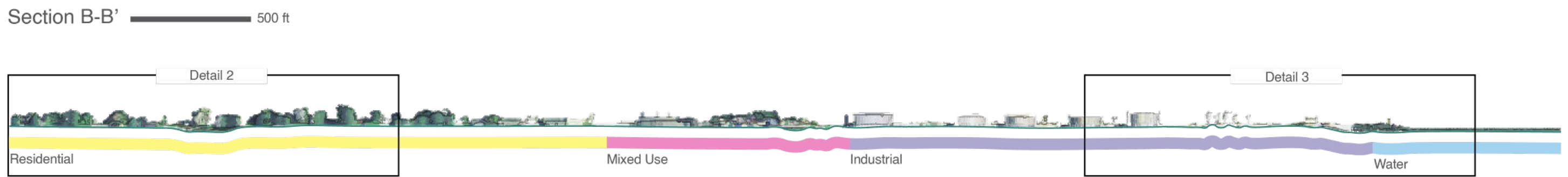
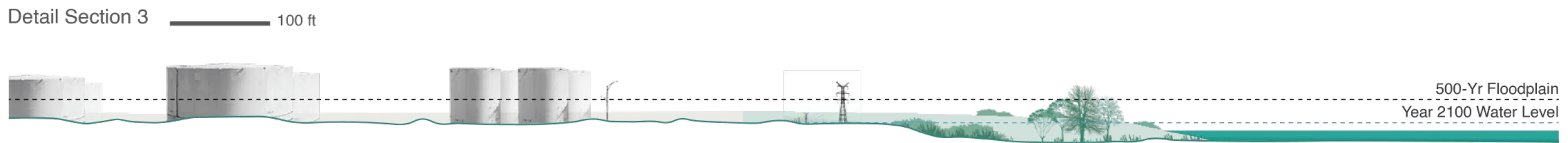


Section A-A'  500 ft



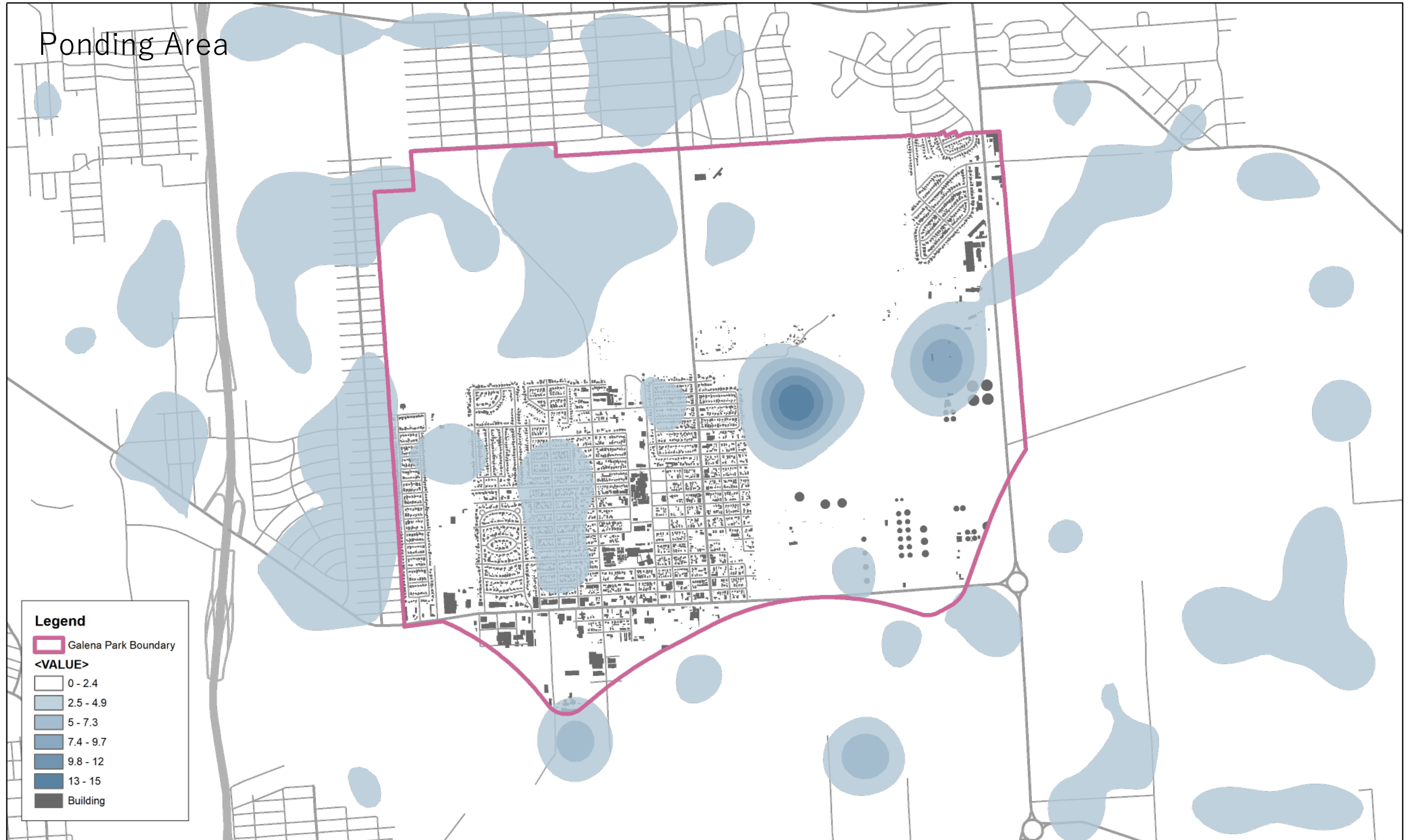
# Riparian Zone Section View

Locator 2

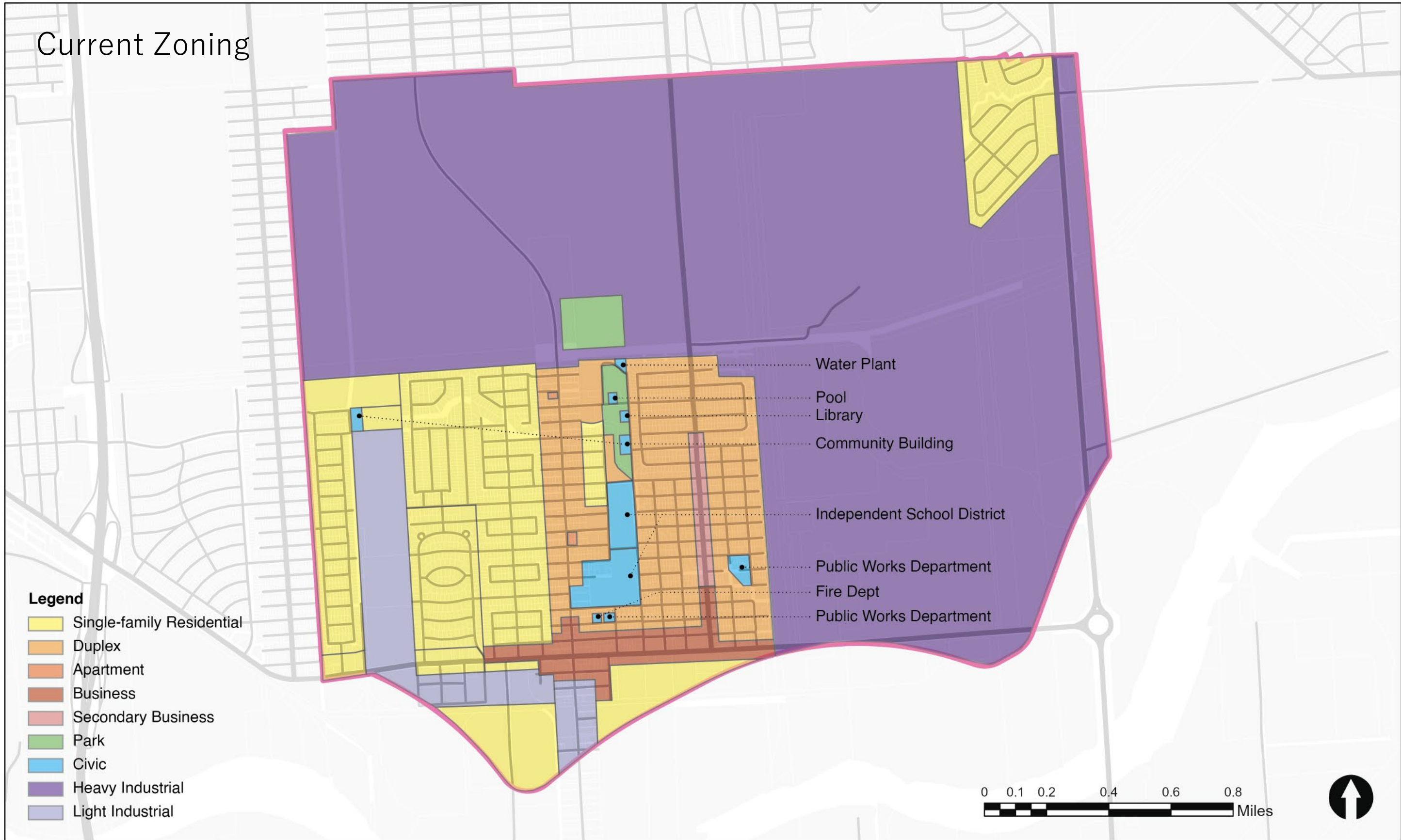




Ponding Area



# Current Zoning



## Legend

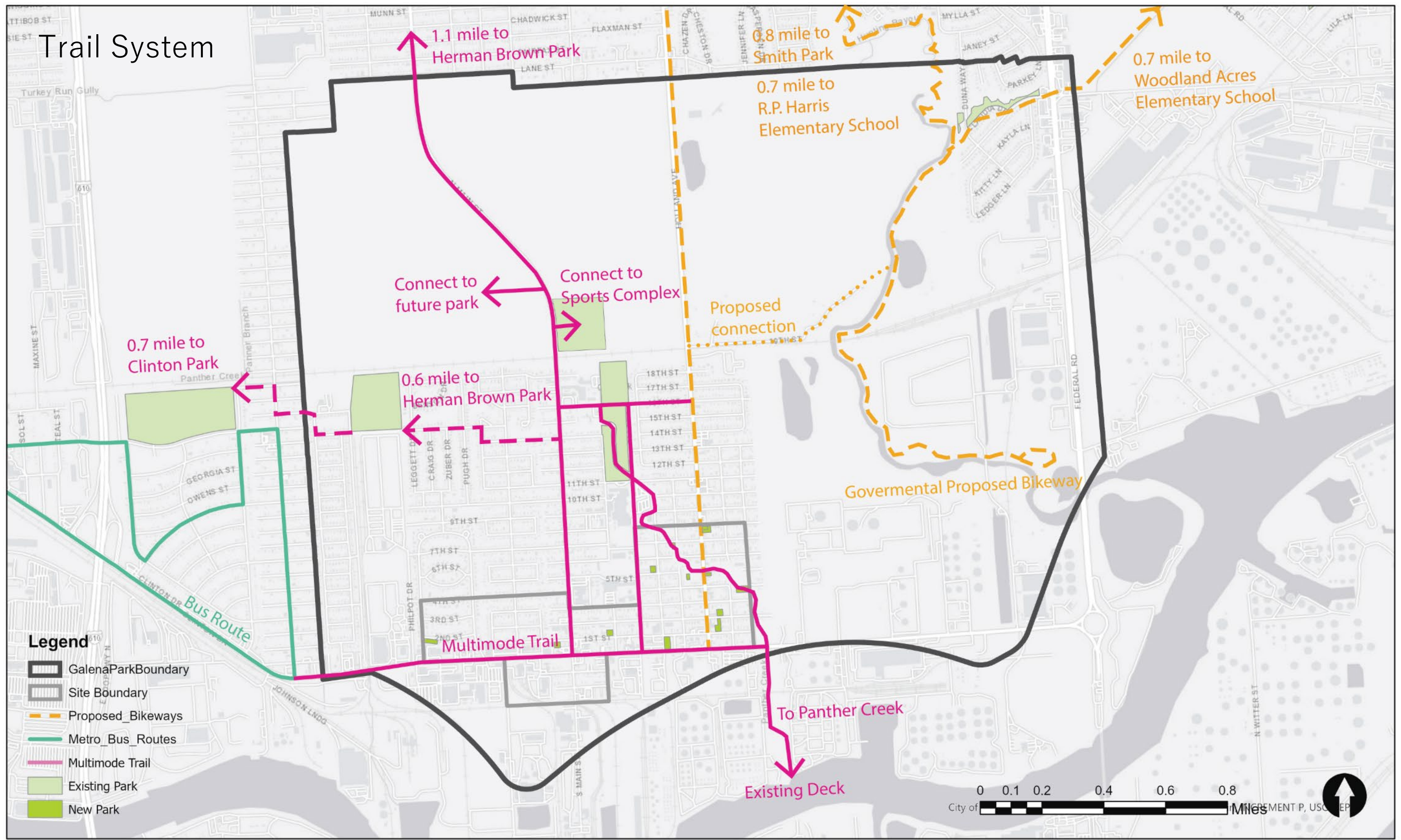
- Single-family Residential
- Duplex
- Apartment
- Business
- Secondary Business
- Park
- Civic
- Heavy Industrial
- Light Industrial

- Water Plant
- Pool
- Library
- Community Building
- Independent School District
- Public Works Department
- Fire Dept
- Public Works Department

0 0.1 0.2 0.4 0.6 0.8 Miles

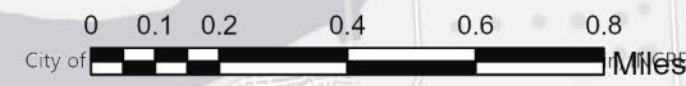


# Trail System



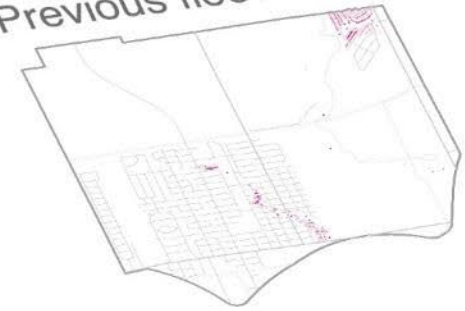
## Legend

- Galena Park Boundary
- Site Boundary
- Proposed Bikeways
- Metro Bus Routes
- Multimode Trail
- Existing Park
- New Park



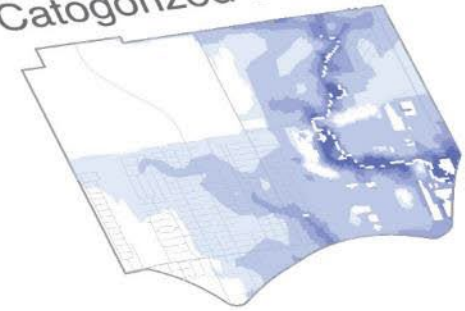
# Flood and Contaminant Risk Maps

Previous flood damage



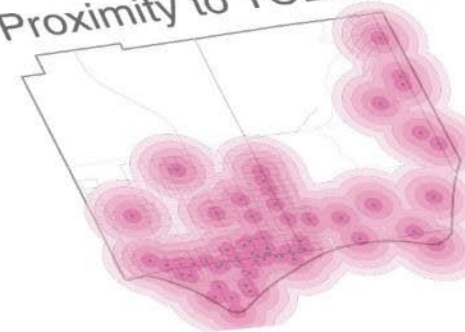
- No Damage
- Affected
- Minimal Damage
- Major Damage
- Destroyed

Categorized storm surge



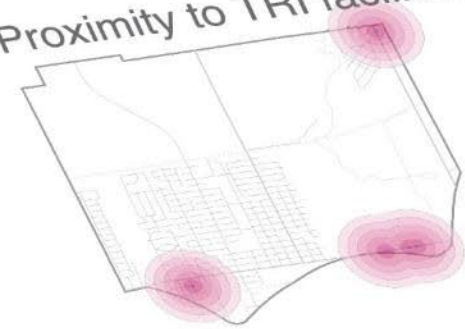
- Category 1 Surge
- Category 2 Surge
- Category 3 Surge
- Category 4 Surge
- Category 5 Surge

Proximity to TCEQ facilities



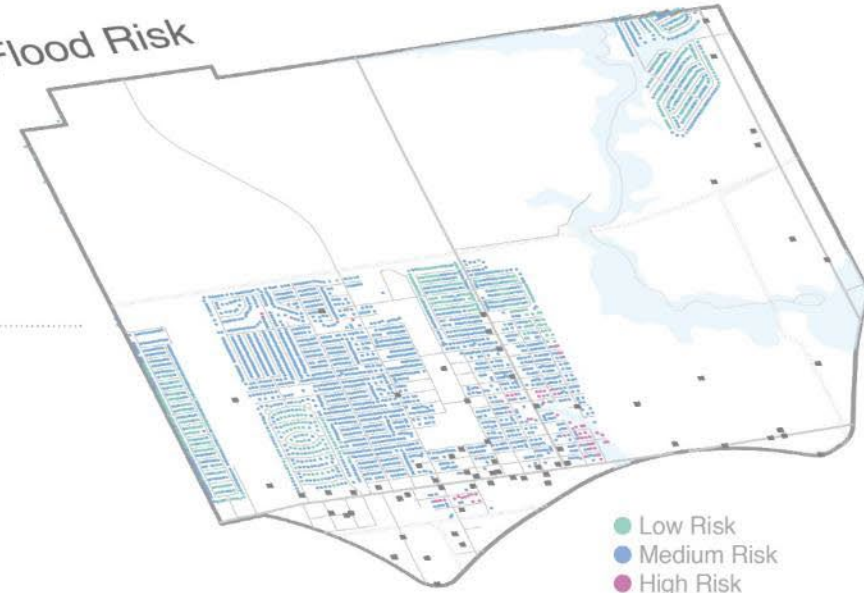
- 0-100 m
- 100-200 m
- 200-300 m
- 300-400 m
- 400-500 m

Proximity to TRI facilities



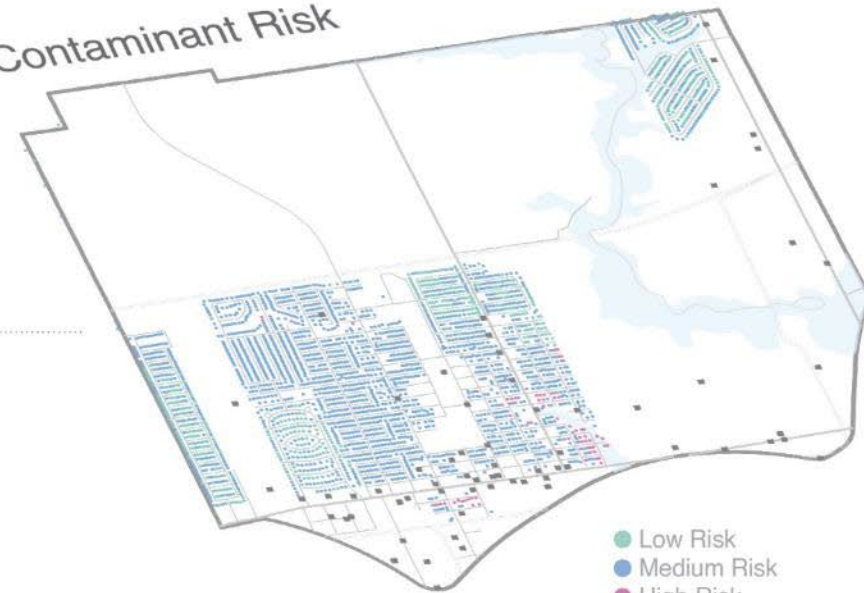
- 0-100 m
- 100-200 m
- 200-300 m
- 300-400 m
- 400-500 m

Flood Risk



- Low Risk
- Medium Risk
- High Risk
- 100-yr Floodplain
- TRI/TECQ Facilities

Contaminant Risk



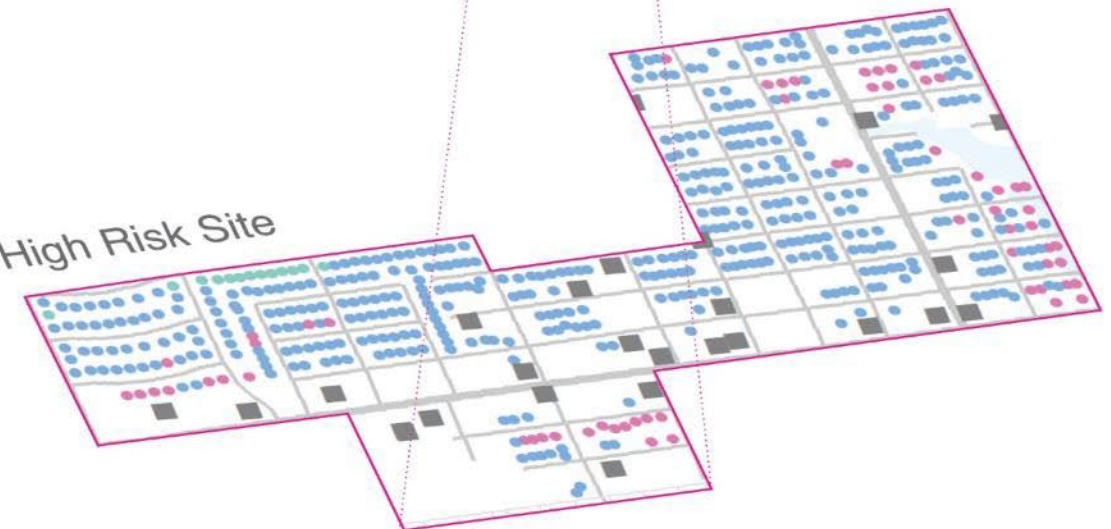
- Low Risk
- Medium Risk
- High Risk
- 100-yr Floodplain
- TRI/TECQ Facilities

Overall Risk



- Low Risk
- Medium Risk
- High Risk
- 100-yr Floodplain
- TRI/TECQ Facilities

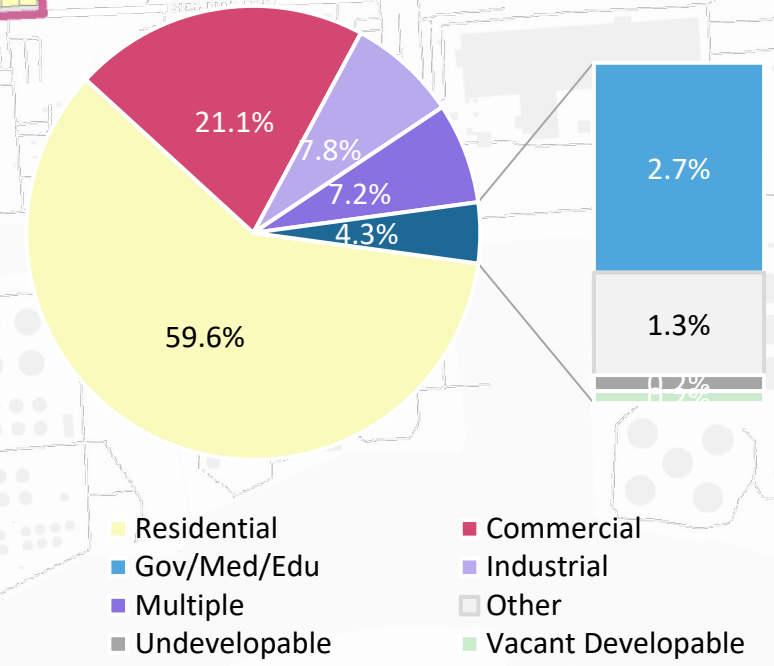
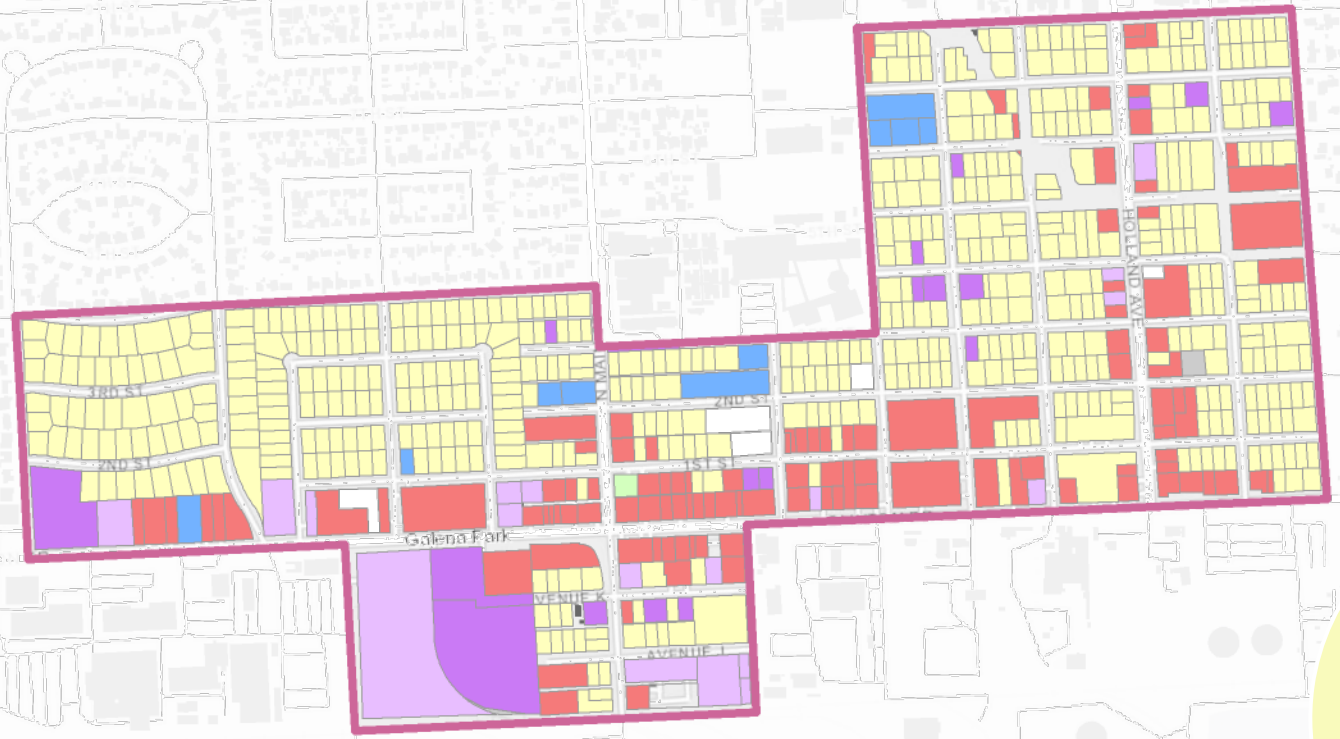
High Risk Site



# Land Use

## Legend

- Boundary
- LU\_Simple**
- Label\_Current\_Land\_Use**
- Residential
- Commercial
- Gov/Med/Edu
- Industrial
- Multiple
- Other
- Undevelopable
- Unknown
- Vacant Developable (includes Farming)
- LiDAR\_Building\_Footprints\_2018



# Point of Interest





# Buildings

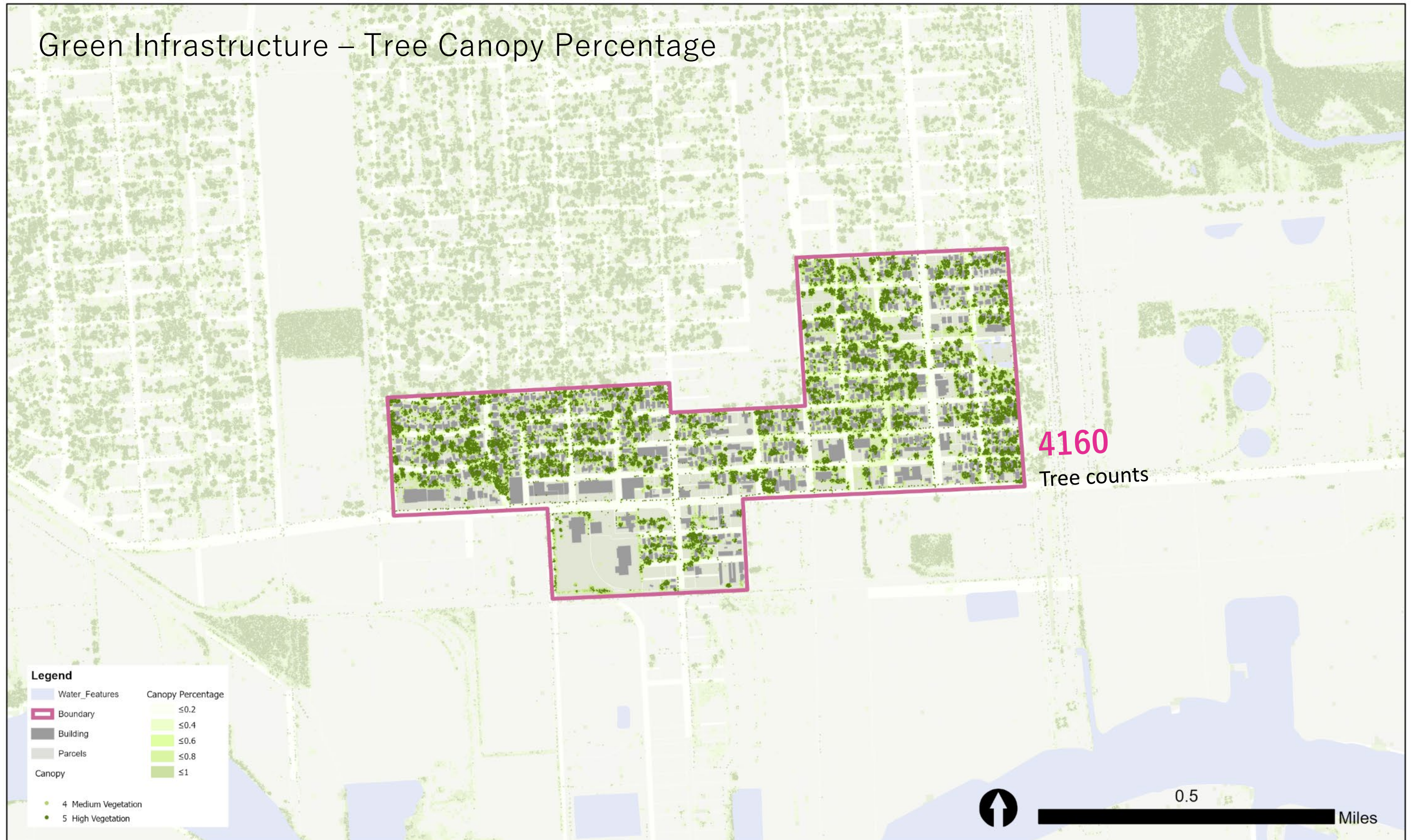
209.3 Acre

869 Buildings

## Legend

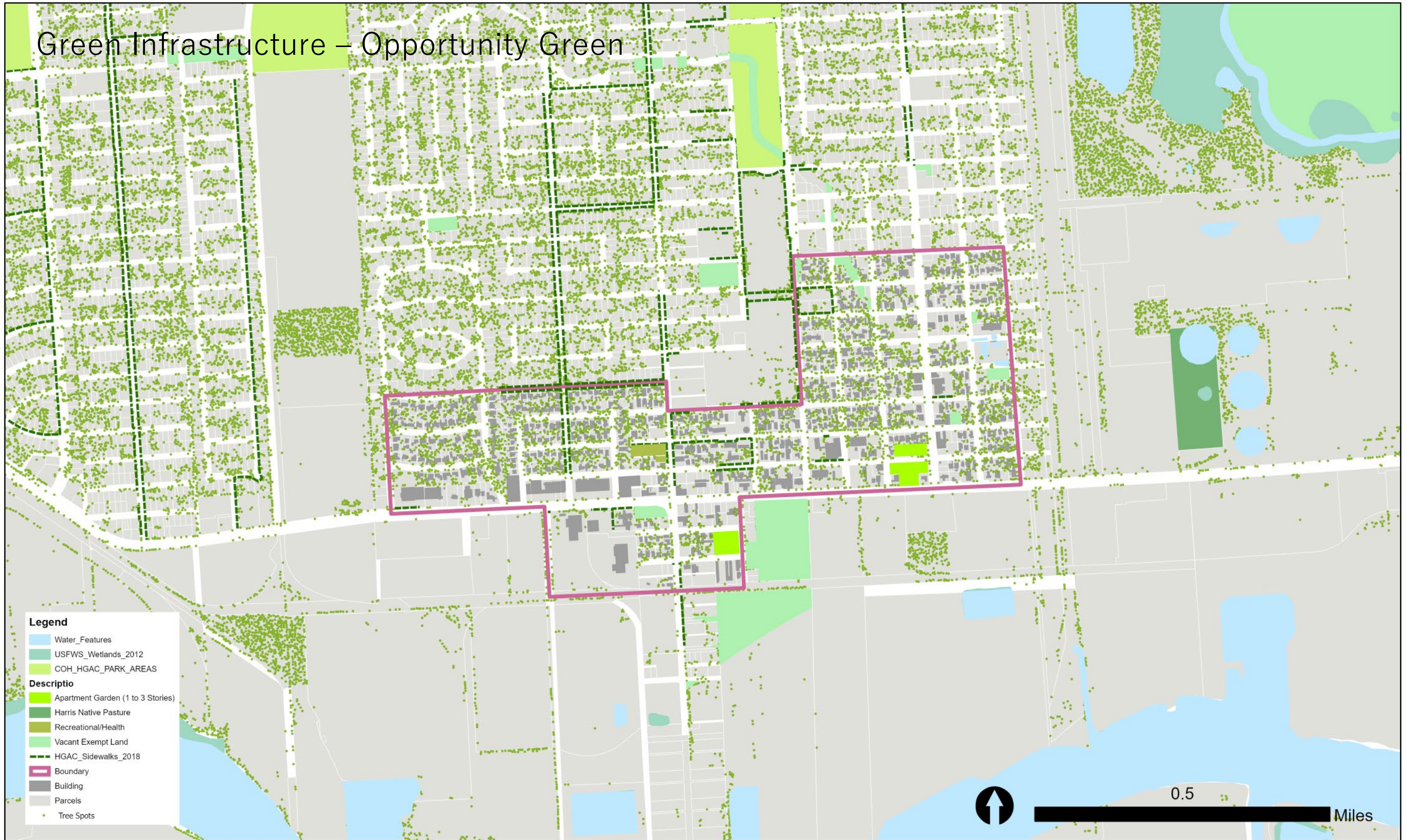
-  Boundary
-  LiDAR\_Building\_Footprints\_2018

# Green Infrastructure – Tree Canopy Percentage





# Green Infrastructure – Opportunity Green



**Legend**

- Water\_Features
- USFWS\_Wetlands\_2012
- COH\_HGAC\_PARK\_AREAS

**Descriptio**

- Apartment Garden (1 to 3 Stories)
- Harris Native Pasture
- Recreational/Health
- Vacant Exempt Land
- HGAC\_Sidewalks\_2018
- Boundary
- Building
- Parcels
- Tree Spots

0.5 Miles

# Green Infrastructure Strategy

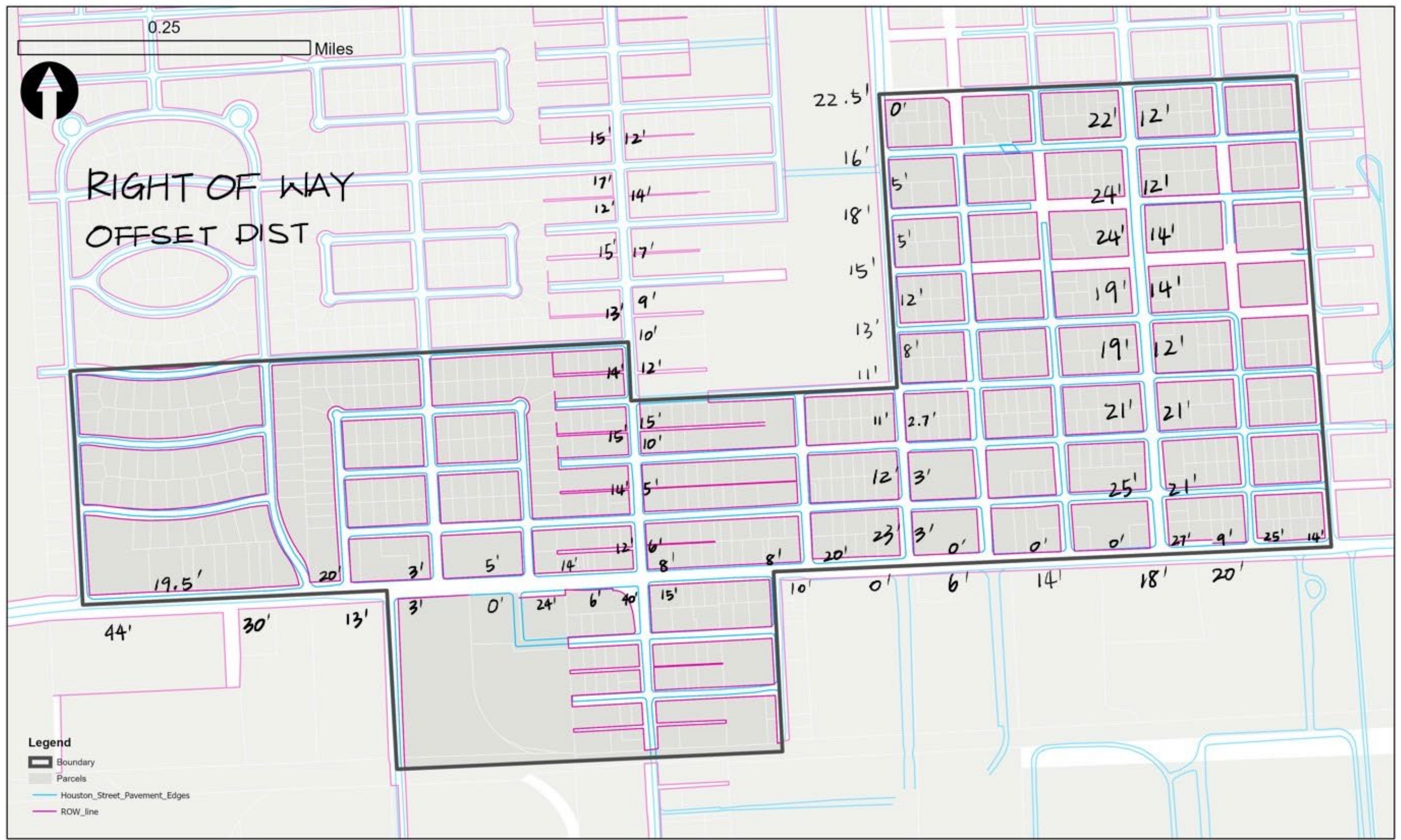


0.25

Miles



# RIGHT OF WAY OFFSET DIST



### Legend

- Boundary
- Parcels
- Houston\_Street\_Pavement\_Edges
- ROW\_line

15' 12'

17' 12'  
14'

15' 17'

13' 9'

10'

14' 12'

15' 15'  
10'

14' 5'

14' 12'  
6' 8'

24' 6' 40'

15'

22.5'

16'

18'

15'

13'

11'

11' 2.7'

12' 3'

20' 23' 3' 0' 0' 0'

10' 0' 6' 14' 18' 20'

0'

5'

5'

12'

8'

11'

12'

20'

10'

22' 12'

24' 12'

24' 14'

19' 14'

19' 12'

21' 21'

25' 21'

0' 0' 0'

14' 18' 20'

12'

12'

14'

14'

12'

21'

21'

27' 9' 25' 14'

18' 20'

44'

30'

13'

19.5'

20'

3'

5'

14'

12'

8'

8'

20'

23'

3' 0'

0'

0'

0'

27'

9'

25'

14'

# Right-of-Way (ROW) Offset Distance

- 0-5' ROW Offset
- 6-14' ROW Offset
- 15-20' ROW Offset
- 21-25' ROW Offset
- >25' ROW Offset

## Legend

Parcels

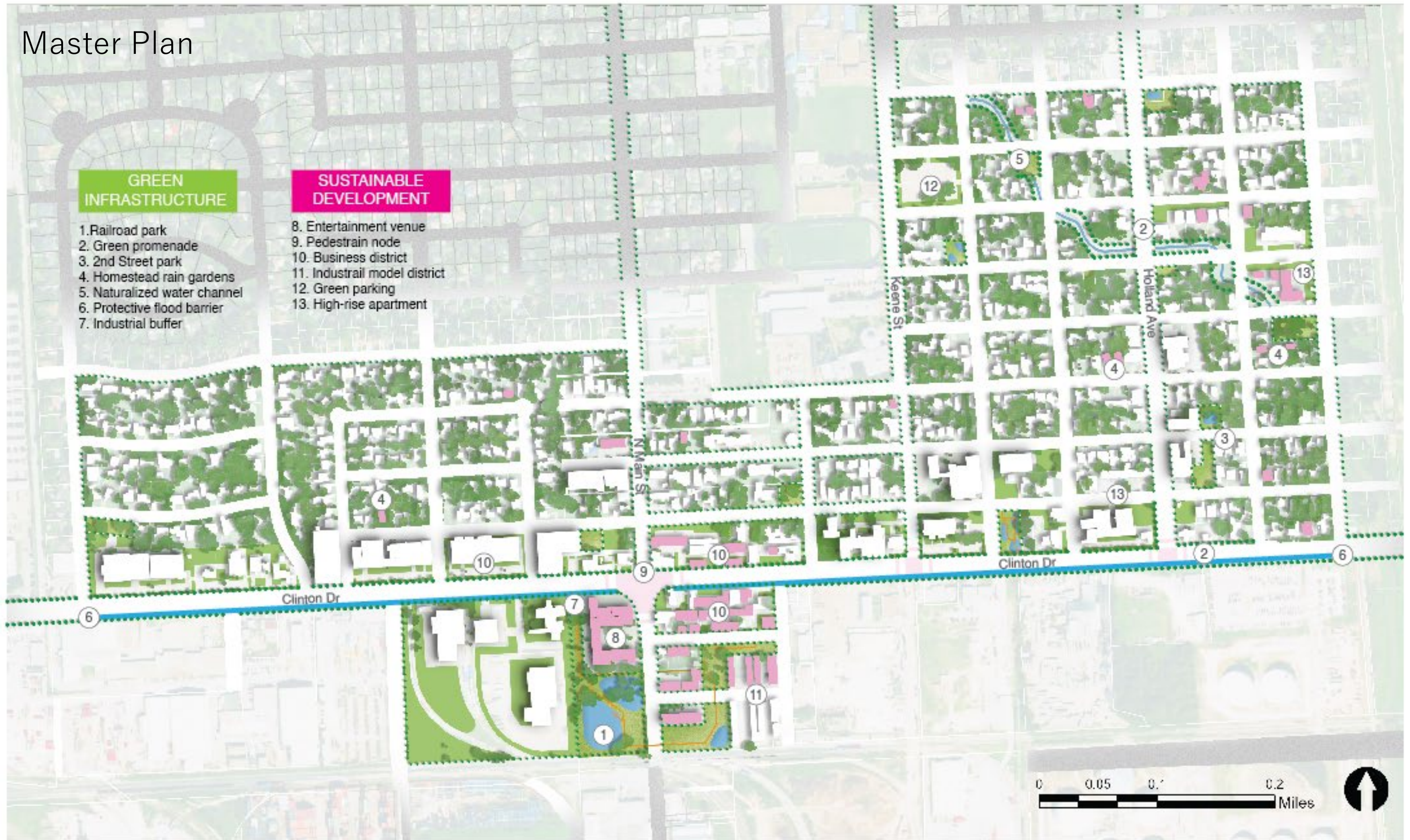
0 0.03 0.06 0.12 0.18 0.24 Miles



# Green Infrastructure Stormbox Toolbox: Pipe Depth vs. ROW Width



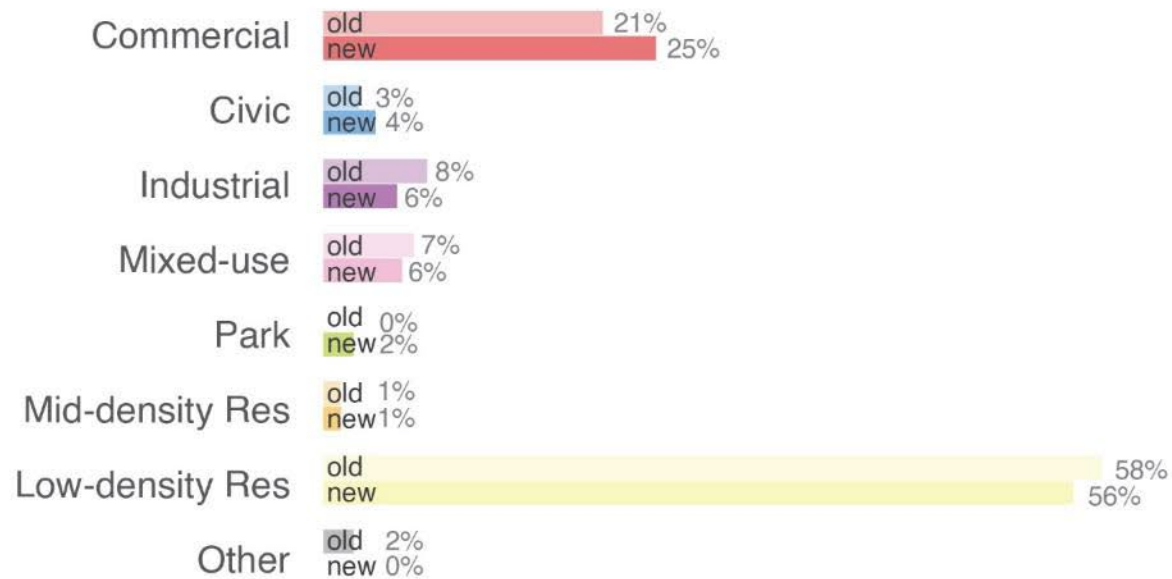
# Master Plan



# Conceptual Plan

## Land use

High-value land uses are concentrated along the designated main roads. Industrial zones are separated from residential areas. Parks are arranged at optimal locations in the neighborhood to form a green infrastructure network.

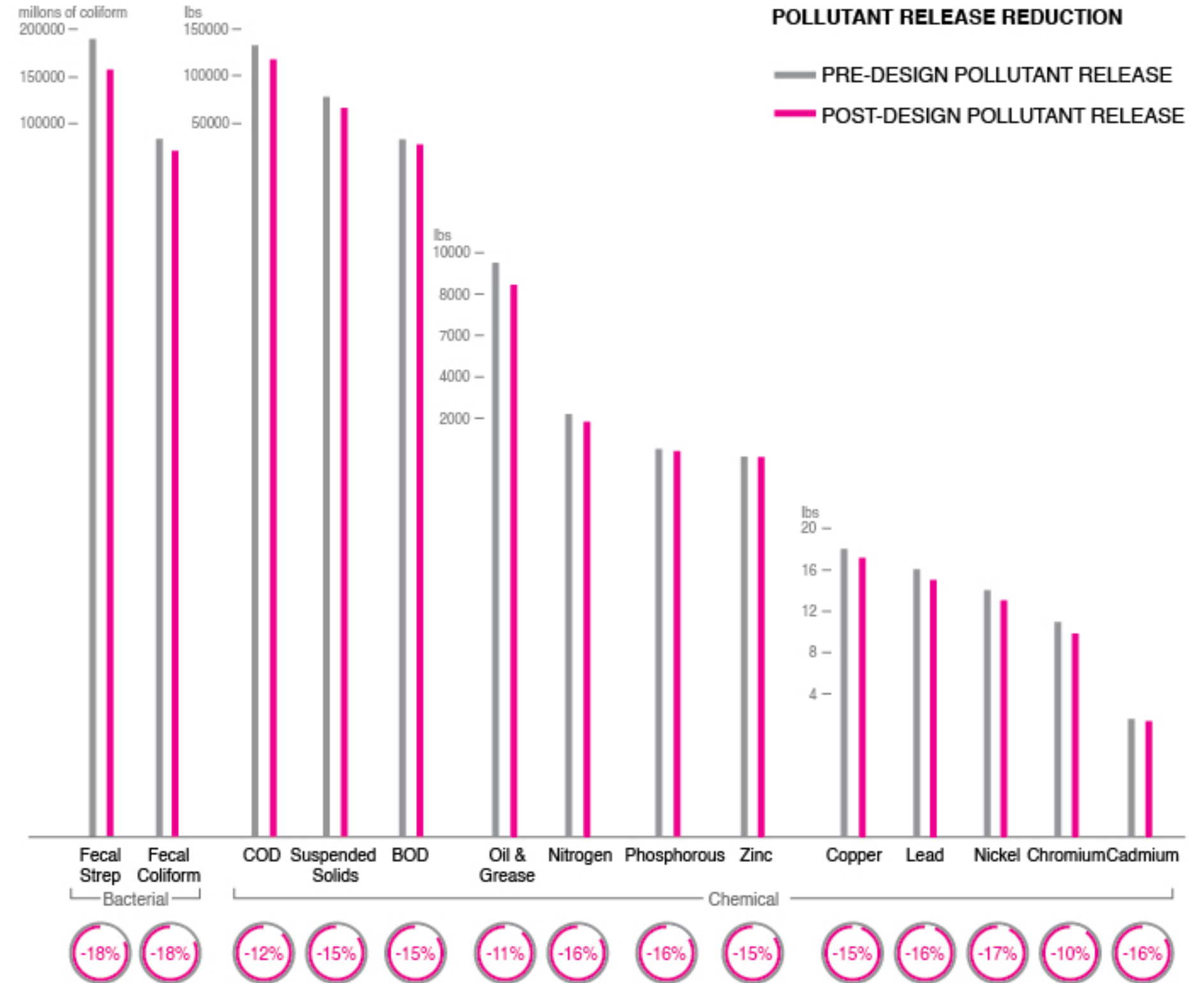
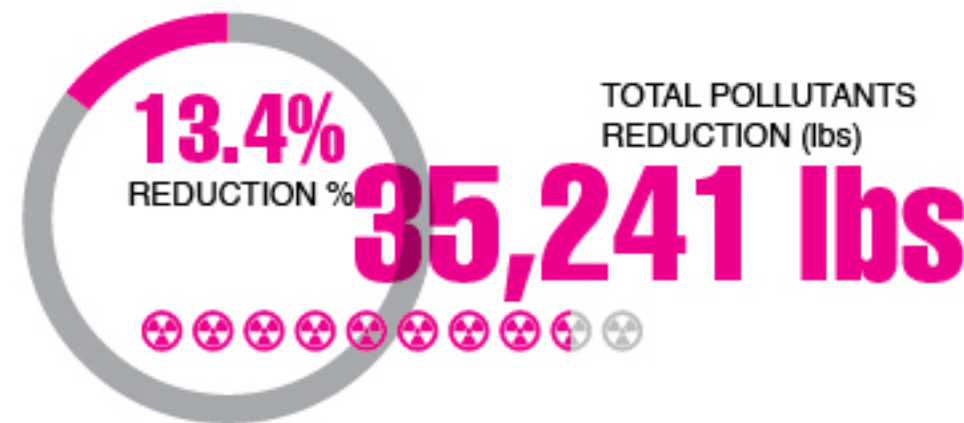
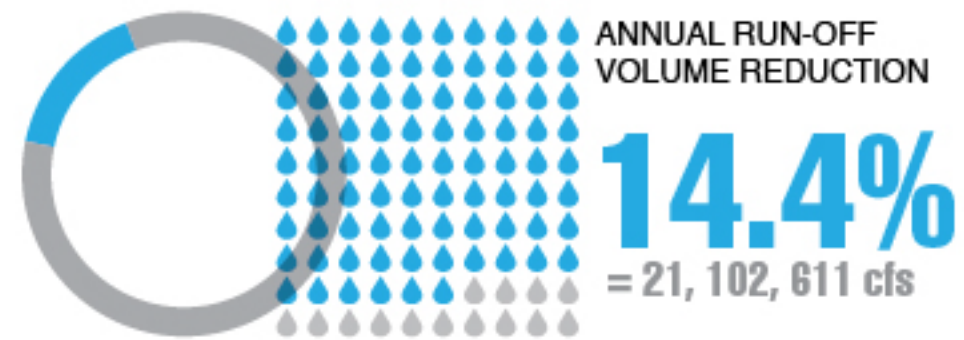
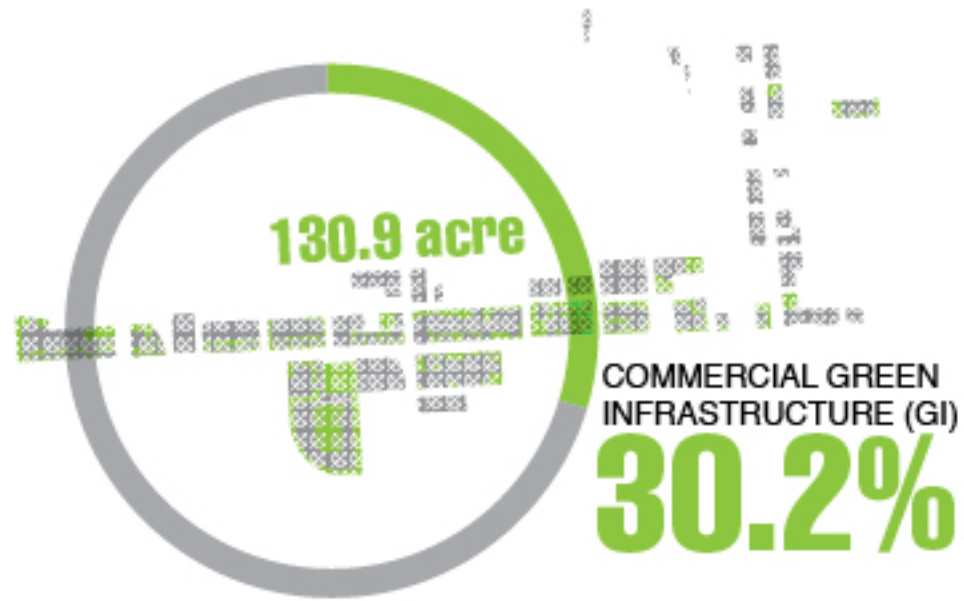


## Residence relocation

Residences in adjacent to industrial zones are at higher risks of being exposed to hazardous substances, thus should be relocated further. Green infrastructures installed along the main streets will effectively reduce hazardous substances transferring.



# Design Impact (Basic L-THIA Model)



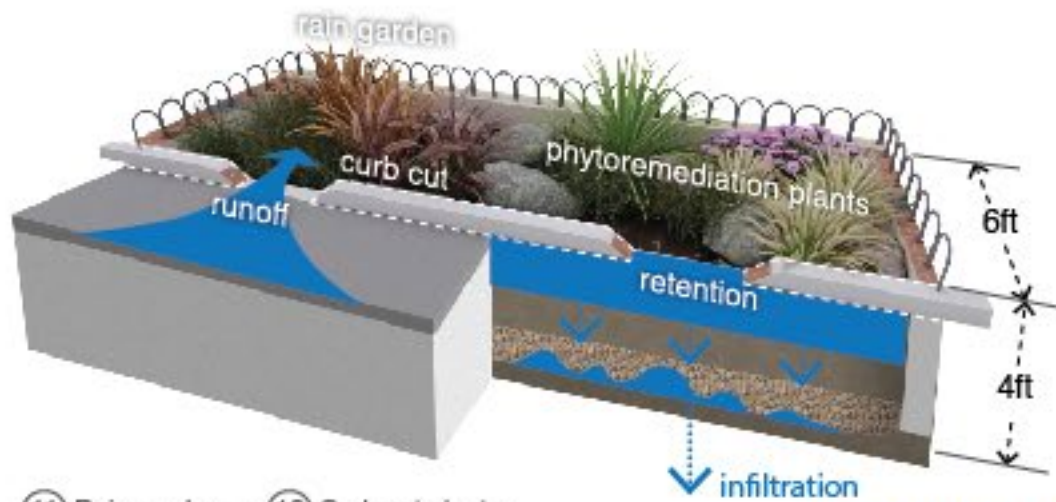
Source: [Low-Impact Development L-THIA \(purdue.edu\)](http://Low-Impact Development L-THIA (purdue.edu))



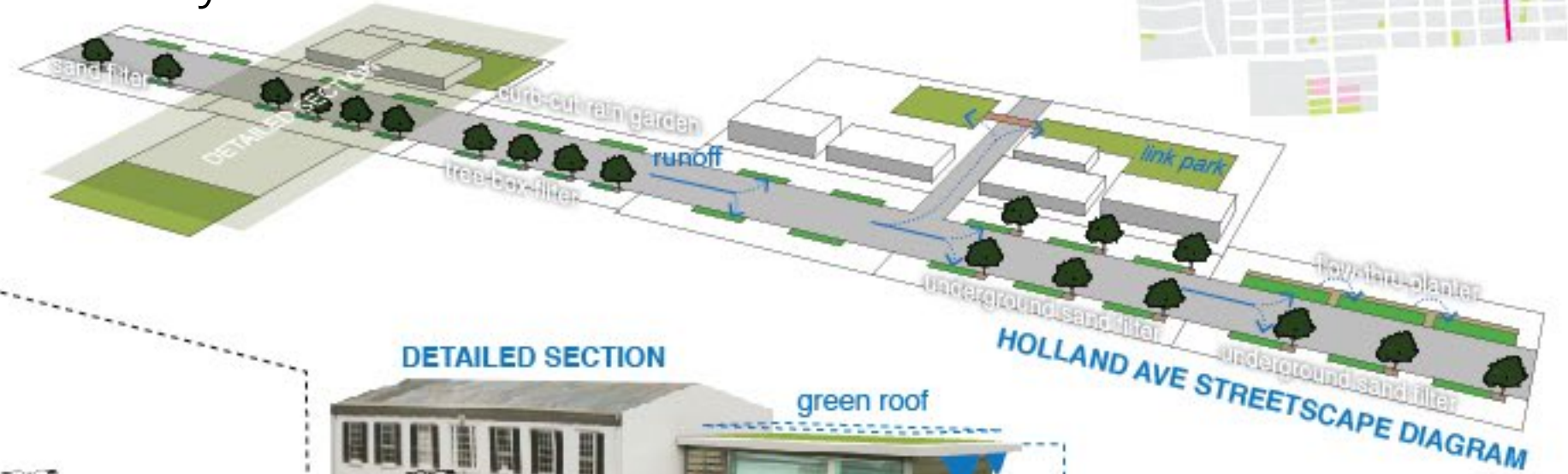
# Green Infrastructure “Assemblage Units”



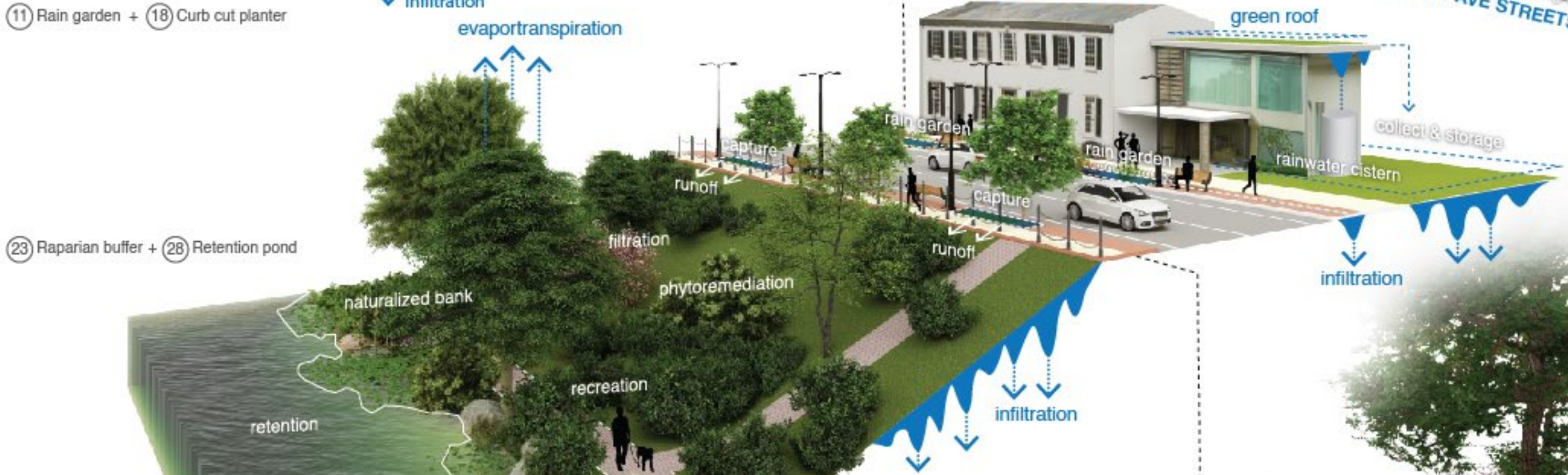
# Assemblage Unit: Streetscape & Retention System



⑪ Rain garden + ⑱ Curb cut planter

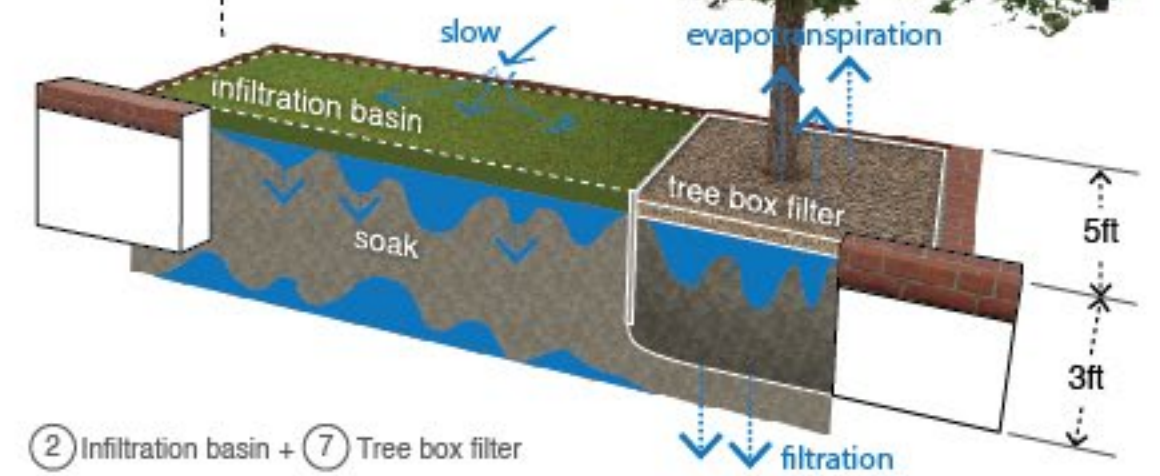


## DETAILED SECTION



⑳ Riparian buffer + ㉔ Retention pond

Annual pollutant reduction  
13.4%



② Infiltration basin + ⑦ Tree box filter

# Assemblage Unit: Streetscape & Green Parking

① Surface sand filter + ② Infiltration basin + ②⑤ Green parking





# Assemblage Unit: Residential Rain Garden

⑰ rainwater harvesting + ⑪ rain garden

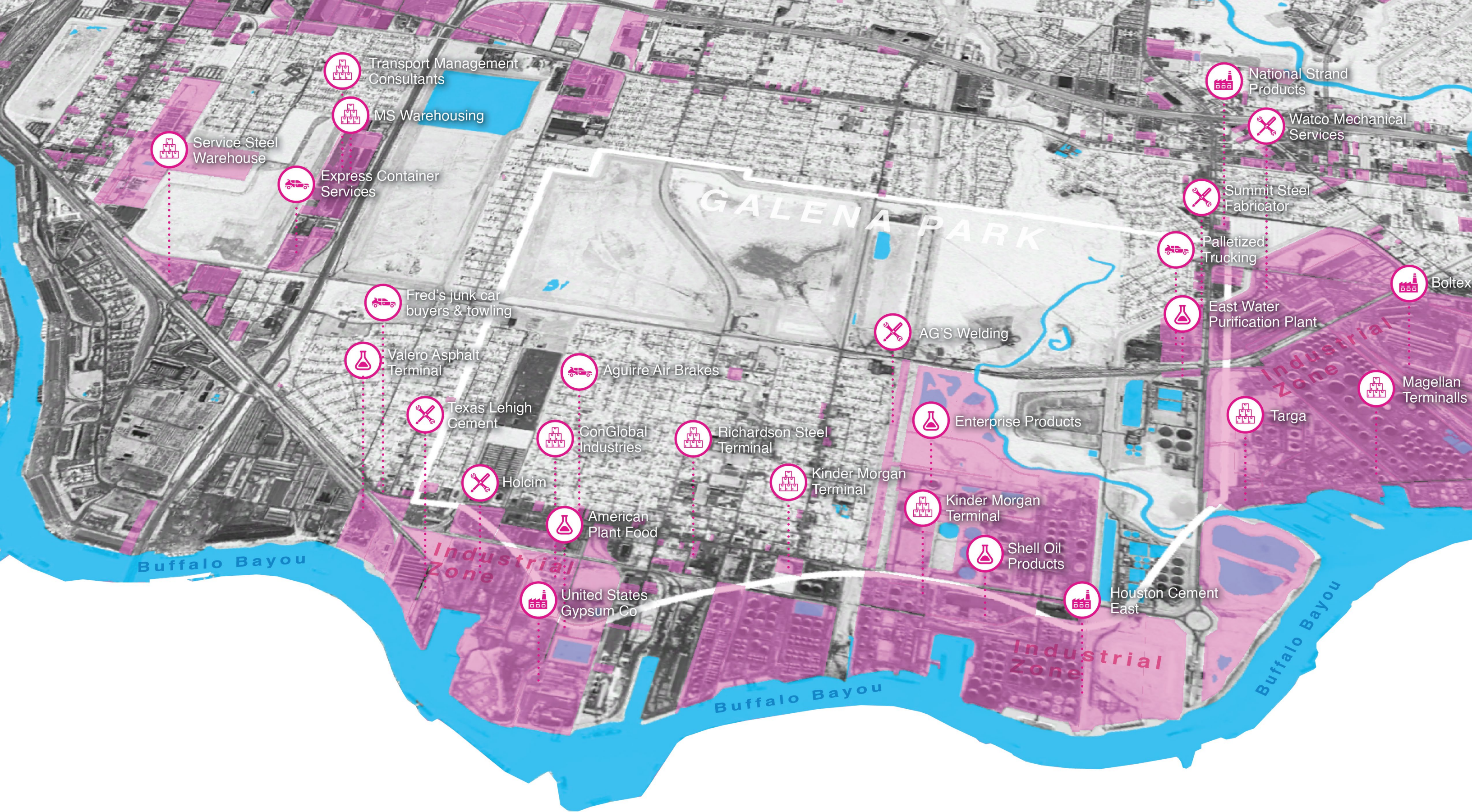
site locator



# Assemblage Unit: Industrial Model District

①① rain garden + ①③ planter box + ②① extensive green roof + ②⑤ green parking





**THANK YOU!**